



Spectroscopic probes of the quasi-liquid layer on ice

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We have used a combination of glancing-angle Raman scattering and laser-induced fluorescence spectroscopy to interrogate the local environment of the quasi-liquid layer (QLL) at the interface between the ice surface and air. The shapes of the OH-stretch bands in the Raman spectra indicate that the environment at the air–ice interface is different from that at the air–water interface and also from that seen in bulk water. Changes in the local environment of the surfacial water molecules may be induced by the presence of different solute species: dissolved sodium chloride disrupts hydrogen bonding at the air–ice interface; however, when gas phase acids are adsorbed from the gas phase onto an ice surface, the opposite effect is seen. At the same time, shifts in the laser-induced fluorescence spectra of acridine, a fluorescent pH-probe present at the air–ice interface, indicate that dissociation of acids occurs there. Subsequent doping by gas phase ammonia reverses the effect. These observations suggest that formation of hydronium ions takes place at the air–ice interface and that this enhances the hydrogen bonding of surfacial water molecules. We will discuss recent results on acid uptake onto ice surfaces and its temperature dependence.